REMARKS

This amendment is responsive to the Office Action of April 22, 2004. Claims 1-32 were presented for examination and all claims were rejected. Claims 1 and 6 were rejected under 35 U.S.C. § 102(b) as being anticipated by Sharma et al. (U. S. Patent No. 5,862,519). Claims 10, 12-14, 15, 18-19, 20, 22-25, 28, and 29 were rejected under 35 U.S.C. § 102(b) as being anticipated by Juang et al. (U. S. Patent No. 5,812,972). Claims 2-5, 7-9, and 30 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Sharma et al. Claims 11, 16, 18, 22 (rather 21? - see next paragraph), and 26-27 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Juang et al., in view of Sharma et al. And, claims 31-32 were rejected under 35 U.S.C. § 103(a) as being obvious over Muroi (U.S. Patent No. 4,918,731).

Claims 17 and 21 were indicated as being rejected in the Office Action Summary, but the specific rejections therefor were not presented in the Detailed Action. For purposes of advancing the prosecution of this application, Applicants shall assume that claim 17 was rejected under 35 U.S.C. § 102(b) as being anticipated by Juang, since its independent claim 15 from which it depends and claim 19 which depends from it were both rejected for this reason. As flagged above, claim 22 was rejected under both §§ 102 and 103, and Applicant shall assume a typographical error where claim 21 rather than claim 22 was intended to be rejected as being unpatentable over Juang et al. in view of Sharma et al. since that assumed rejection appears to be most likely in view of the Examiner's position with respect to the other claims in the application. If these

assumptions are incorrect would the Examiner please advise accordingly in the next office action.

Claims 1, 5, 6, 10, 15, 20, 29, 30, 31, and 32 are independent claims. All independent claims have been amended to incorporate certain limitations of certain dependent claims relating to the difference between the numbers of peaks, also termed the number of peaks difference (NPD). Also, dependent claims 9, 17, 18, 22, and 23, have been amended for conformance purposes. Dependent claims 2-3, 7-8, 11, 16, 21, have been canceled because their limitations were incorporated into their respective independent claims. Claims 1, 4-6, 9-10, 12-15, 17-20, and 22-32 remain pending. Applicants respectfully traverse the rejection of these pending claims for the following reasons.

CLAIMS 1 AND 6 AND THEIR DEPENDENCIES

Claims 1 and 6 were rejected under 35 U.S.C. § 102(b) as being anticipated by Sharma et al. but have been amended to overcome this rejection. Claim 1, for example, has been amended to include the limitations of canceled claims 2 and 3 which were rejected under 35 U.S.C. § 103(a) as being unpatentable over Sharma et al. Therefore, the 35 U.S.C. § 102(b) rejection of amended claim 1 should be withdrawn.

With respect to the 35 U.S.C. § 103(a) rejection, amended claim 1 now recites, *interalia*:

> determining a number of peaks in the cepstral coefficients for each received frame of acoustic data; and segmenting the received frames of acoustic data based on the determined number of peaks in the cepstral coefficients.

With respect to these limitations, the Examiner takes the position that "it would have been obvious to one of ordinary skill in the art at the time the invention was made to

modify Sharma to use the difference in the number of cepstral peaks instead of SVF, because these methods track the same cepstral properties in a similar fashion. Computing the difference in the number of peaks is a variation of SVF, and while not being as exact as SVF, it has the advantage of computational simplicity." (Office Action, page 8, top) Applicant respectfully disagrees for the following reasons.

To begin with Sharma et al does not rely upon cepstral coefficients which are recited in Applicants' claim but, as the Examiner notes, upon a spectral variation function (SVF) that is based on the Euclidean norm of a *delta* cepstral coefficient (Column 6, lines 31-33). And, *delta cepstral coefficients* are quite different from *cepstral coefficients*. According to Sharma et al., "The cepstral coefficients represent the log of the time-varying, short-time spectrum of speech..." (column 6, lines 33-34). Cepstral coefficients represent rate of change in the different log-magnitude scaled spectrum bands. (Tukey, J. W., B. P. Bogert and M. J. R. Healy: "The Quefrency Analysis of Time Series for Echoes: Cepstrum, Pseudo-Autocovariance, Cross-Cepstrum, and Saphe-cracking". "Proceedings of the Symposium on Time Series Analysis" (M. Rosenblatt, Ed) Chapter 15, 209-243. New York: Wiley.) But, "the time derivative of the cepstral coefficients represent the variation of speech spectrum with time" (column 6, lines 35-36). The *delta* cepstral coefficients are an approximation of the time derivative. In fact, Sharma et al defines *delta* cepstral coefficients as the first order coefficient of an orthogonal polynomial to represent the *spectral slope* (Sharma et al., column 6, lines 43-45). Thus, *delta* cepstral coefficients have to do with the *slope* of a spectral curve and thereby provide insight about how a magnitude such as audio power might vary, but otherwise have nothing to do with cepstral coefficients, per se. In fact, use of *delta*

cepstral coefficients teaches away from cepstral coefficients as claimed and used in the instant application, as explained below.

Applicant's Fig. 2 represents a cepstral coefficient plot of magnitude vs. sequence number for a frame of audio data. This frame appears at an instant in time. The next successive frame appears at a later instant in time and can be either identical to or different from the plot shown. In a simplified analysis employed to enhance clarity of illustration, let the mathematical function $f_1(x)$ represent a cepstral coefficient plot in a first frame and let $f_2(x)$ represent that plot in the next consecutive frame. These plots could be identical or similar to that shown in Fig. 2, where "x" is the "variable" representing the cepstral coefficients. (It is clear that the cepstral coefficients are discrete points in the plot, but we shall let these functions be continuous for purposes of simplification; no substantive meaning is lost or masked thereby.) Then, the quantity $[f_2(x) - f_1(x)]$ can be taken to reasonably represent the *delta* cepstral coefficient which is a rough approximation of the first time derivative. SVF is a familiar function to those of skill in this art, and it would be understood to those to be roughly equivalent to the integral over the "x" domain of $[f_2(x) - f_1(x)]^2$. This formulation of SVF is useful to show how SVF teaches away from use of cepstral coefficients as recited in Applicants' claims, which can be illustrated as follows.

If conditions exist where $f_1(x) = f_2(x)$, then the two consecutive frames as shown in Applicants' Fig. 2 plot are identical and the peaks are in the same relative place in both frames. This means that the plots have not changed from the first instant in time to the next instant in time. For this condition, the delta cepstral coefficient as defined above is equal to zero since it is based on $[f_2(x) - f_1(x)]$. For illustrative purposes, if the functions

$f_1(x) = f_2(x)$ are taken to be continuous sine waves of a single frequency which are in phase with each other and which have the same amplitude as each other, then the delta cepstral coefficient expression is zero. But, if one sine wave shifts in phase relative to the other, the expression becomes non-zero, and if shifted 180 degrees, the difference between the sine wave amplitudes is <u>maximum</u>. BUT THE NUMBER OF PEAKS DIFFERENCE REMAINS ZERO from one frame to the next. The number of peaks does not change and remains the same in each sine wave, namely one positive peak per cycle, regardless of phase shift. Similarly, if the phase does not shift but if the $f_1(x)$ sine wave increased in amplitude relative to the $f_2(x)$ sine wave, for example, again the expression becomes non-zero, BUT THE NUMBER OF PEAKS DIFFERENCE AGAIN REMAINS ZERO from one frame to the next. The number of peaks difference does not increase, and remains the same in the sine wave, namely one positive peak per cycle regardless of amplitude increase of one wave vs. the other. Thus the measurements obtained by these two techniques, the SVF technique vs. the NPD technique, are shown to be completely contradictory, at least for this sine wave example.

For another example, if $f_1(x) = f_2(x) =$ constant (flat line), the difference between these functions representing the difference between consecutive audio frames is again zero. Thus, in this example, SVF is zero. But, if one of the two functions were manipulated into an almost imperceptible, but finite, sine wave, a concomitantly small change in SVF from zero in would occur when one function is subtracted from the other, BUT THE PERCENTAGE CHANGE IN PEAK DIFFERENCE WOULD BE <u>INFINITE</u> (from zero peaks in a flatline to non-zero peaks in an almost imperceptibly small sine wave). Thus the measurements obtained by these two techniques, the SVF technique vs.

the NPD technique, are again shown to be completely contradictory, at least for this flatline example.

These examples highlight the fact that SVF tracks relative magnitude difference and relative phase difference of consecutive cepstral coefficient frames but, by contrast, Applicants' algorithm which relies upon the number of peaks difference ignores these relative magnitude and phase differences. In fact, NPD is invariant to these differences. This inherent distinction between SVF and NPD is very important, as the results obtained using one or the other technique can be dramatically different, as illustrated. One of ordinary skill in the art, at the time that Applicants conceived the invention defined by the claims in this application, having access only to Sharma et al. in accordance with the Examiner's position on pages 7/8 of the Office Action, would be taught about SVF. Any such individual with an understanding of the disclosure of Sharma et al. would therefore necessarily understand that SVF tracks the relative magnitude difference and relative phase difference between consecutive frames. That individual would thus appreciate the importance of that tracking to the taking of the measurements and to the obtaining of the results with respect to audio data frames 1 and 2. Such understanding and appreciation would NOT suggest to that individual to search in a completely different direction where these magnitude and/or phase differences are not only NOT important, but are entirely irrelevant! Thus, one of ordinary skill in this art, consulting only Sharma et al. at the time when Applicants' invention was conceived, and understanding what SVF represents, would not think in terms of moving in an opposite direction of an algorithm dependent upon NPD. SVF (relying upon *delta* cepstral coefficients) simply does not suggest NPD

(relying upon cepstral coefficients), regardless of their reliance upon similar-sounding terminology.

At least in this respect, SVF teaches away from NPD and, therefore, Sharma et al. teaches away from Applicants' amended claim 1. By contrast, Applicants' insight into the claimed subject matter based on NPD necessarily takes into account the fact that relative magnitude and relative phase between consecutive frames do not matter in terms of providing useful, reliable, and accurate results when employing NPD. Applicants gained such insight by examining and considering cepstral coefficient frames and boundaries and after thoughtful effort, arriving at the unique and novel realization that relative magnitude and/or phase differences of the cepstral coefficients from frame to frame are irrelevant for phoneme boundary segmentation. NPD is a technique that takes advantage of this realization and is function that has these special properties.

Amended claim 1 recites, *inter*-alia: "determining a number of peaks in the cepstral coefficients for each received frame of acoustic data; and segmenting the received frames of acoustic data based on the determined number of peaks in the cepstral coefficients", and at least these limitations are not disclosed or suggested by Sharma et al. for at least the reasons discussed above. In accordance with MPEP 2143, to establish a prima facie case of obviousness all of three basic criteria must be met, two of which are moot since only one reference and not a combination of references is being relied upon in rejection of claim 1. The third criteria is that the prior art reference must teach or suggest all claim limitations, and clearly the Sharma et al. reference does not meet that criteria. Accordingly, it is submitted that the 35 U.S.C. § 103(a) rejection of claim 1, should be withdrawn and the claim allowed. Independent claim 6 has been amended to include

limitations of dependent claims 7 and 8 in a manner similar to the amendment to claim 1 to overcome the 35 U.S.C. § 102(b) rejection. The same argument and reasoning presented above applies to amended claim 6 which is likewise allowable over Sharma et al. At least by virtue of their dependencies, claims 4 and 9 are likewise allowable.

CLAIM 5

Independent claim 5, directed to a speech recognition system, was rejected was rejected under 35 U.S.C. § 103(a) as being unpatentable over Sharma et al. Claim 5 is not amended herein since it previously included language relating to determining a number of peaks of cepstral coefficients and comparing a first number of peaks with a second number of peaks in successive frames, etc. Accordingly, it is submitted that the subject matter of this claim is not disclosed or suggested by this reference, that a prima facie case of obviousness has not been made, and that this claim is allowable over Sharma et al. for reasons presented above.

CLAIM 30

Independent claim 30, directed to a data structure, was rejected under 35 U.S.C. § 103(a) as being unpatentable over Sharma et al. This claim recites, inter-alia, "..........cepstral coefficient data including a number of peaks in cepstral coefficients corresponding to each frame of acoustic data, and segmentation data indicating segmentation of the frames of acoustic data based on the cepstral coefficient data including the number of peaks". Accordingly, it is submitted that the subject matter of this claim is not disclosed or suggested by this reference, that a prima facie case of obviousness has not been made, and that this claim is allowable over Sharma et al. for

reasons presented above. It is submitted that the rejection should be withdrawn and the claim allowed.

CLAIMS 10, 15, 20, 29 AND THEIR DEPENDENCIES

Independent claims 10, 15, 20, and 29 directed to either a method of recognizing patterns in acoustic data or to a speech recognition system were rejected under 35 U.S.C. § 102(b) as being anticipated by Juang et al. Each of these claims has been amended in a manner similar to the amendments made to claims 1, 5, and 6 to include the limitations: "determining a number of peaks in the cepstral coefficients for each received frame of acoustic data, and determining at least one weighting parameter based on the determined number of peaks in the cepstral coefficients" or equivalent language. These limitations are not disclosed or suggested by Juang et al, and the Examiner agrees since Juang et al was not cited in connection with claims 1, 5, and 6. Consequently the 35 U.S.C. § 102(b) rejection of these claims should be withdrawn as each and every claim limitation in these amended claims does not appear in Juang et al. Furthermore, any hypothetical 35 U.S.C. § 103 type rejection of these claims based on Juang et al. in view of Sharma et al. should not be applied since the added limitations are those which defined around Sharma et al for reasons noted above. Thus, these independent claims are deemed to be allowable over these references taken alone or combined in any reasonable manner. Claims 11-14 are dependent from claim 10, claims 16-19 are dependent from claim 15, and claims 21-28 are dependent from claim 20. All of these dependent claims are urged to be allowable in view of the allowability of their respective independent base claims.

CLAIMS 31 AND 32

Independent claim 31 and 32, directed to an acoustic recognition system, were rejected under35 U.S.C. § 103(a) as being obvious over Muroi. These claims are amended in a manner similar to the amendments made to claims 1 and 6 to include *inter-alia*: ".....determine a number of peaks of cepstral coefficients for each of the received frames; ....generate, based on the determined number of peaks, end frame numbers for each phoneme......" or equivalent language. These limitations are not disclosed or suggested by Muroi, and the Examiner agrees since Muroi was not cited in connection with claims 1, 5, and 6. Consequently the 35 U.S.C. § 103(a) rejection of these claims should be withdrawn as each and every claim limitation in these amended claims does not appear in Muroi and a prima facie case of obviousness has not been met. Furthermore, any hypothetical 35 U.S.C. § 103 type rejection of these claims based on Muroi in view of Sharma et al. should not be applied since the added limitations are those which defined around Sharma et al for reasons noted above. Thus, these two independent claims are deemed to be allowable over these references taken alone or combined in any reasonable manner.

CONCLUSION

In view of the foregoing amendments and remarks, Applicant respectfully requests the Examiner's reconsideration of this application, and the timely allowance of all pending claims. To the extent necessary, a petition for an extension of time under 37 C.F.R. § 1.136 is hereby made. Please charge any shortage in fees due in connection with

the filing of this paper, including extension of time fees, to Deposit Account No. 07-2347 and please credit any excess fees to such deposit account.

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